PLANT ITEM MATERIAL SELECTION DATA SHEET

FEP-VSL-00005 (PTF)

Waste Feed Evaporator Condensate Vessel

ISSUED BY
RPP-WTP PDC

R10664180

- Design Temperature (°F)(max/min): 150/49
- Design Pressure (psig) (internal): 15
- Location: out cell

Contents of this document are Dangerous Waste Permit Affecting

Operating conditions are as stated on attached Process Corrosion Data Sheet

Materials Considered:

Material (UNS No.)	Relative Cost	Acceptable Material	Unacceptable Material
Carbon Steel	0.23		X
304L (S30403)	1.00		X
316L (S31603)	1.18	X	
6% Mo (N08367/N08926)	7.64	X	
Alloy 22 (N06022)	11.4	X	
Ti-2 (R50400)	10.1		X

Recommended Material: 316 (max 0.030% C; dual certified)

Recommended Corrosion Allowance: 0.040 inch (includes 0.024 inch corrosion allowance and 0.004 inch erosion allowance)

Process & Operations Limitations:

- Develop rinsing/flushing procedure for acid and water

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1/12/06

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This bound document contains a total of 6 sheets.

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Corrosion Considerations:

The vessel receives condensate from the primary condenser

a General Corrosion
In the proposed pH operating range, no information was found for the general/uniform corrosion of stainless steels or other material. Typically, the austenitic and higher alloy steels are expected to have corrosion rates of less than about 1 mpy. This lack of data is not critical because the alloys needed for the system typically fail by pitting, crevice corrosion, or cracking. On this basis, a corrosion allowance has little meaning though a nominal value is given.

Conclusion:
Both 304L and 316L are expected to have little uniform corrosion under the stated conditions and either would be acceptable. A nominal corrosion allowance is given even though it has minimal significance.

b Pitting Corrosion
Chloride is known to cause pitting in acid and neutral solutions. Dillon (2000) is of the opinion that in alkaline solutions, at pH greater than approximately 12, chlorides are likely to promote pitting only in tight crevices. Dillon and Koch (1995) are of the opinion that fluoride will have little effect. Further, Revie (2000) and Uhlig (1948) note that nitrate inhibits chloride pitting.

The vessel has about 0.001 M nitrate and approximately 24 ppm chloride. Nominally, the temperature will be between 111 and 122 °F which, with 24 ppm chloride, is acceptable for 316L stainless steel.

Conclusion:
Localized corrosion, such as pitting, is common but can be mitigated by alloys with higher nickel and molybdenum concentrations. Based on the expected operating conditions the vessel should be 316L stainless steel.

c End Grain Corrosion
End grain corrosion only occurs in metal with exposed end grains and in highly oxidizing acid conditions.

Conclusion:
Not applicable to this system.

d Stress Corrosion Cracking
The exact amount of chloride required to cause stress corrosion cracking is unknown. In part this is because the amount varies with temperature, metal sensitization, and the environment. But it is also unknown because chloride tends to concentrate under heat transfer conditions, by evaporation, and electrochemically during a corrosion process. Hence, even as little as 10 ppm can lead to cracking under some conditions. Generally, as seen in Sedriks (1996) and Davis (1987), stress corrosion cracking does not usually occur below about 140°F.

Given the environment and the lack of heat transfer into the process stream, caustic cracking is not anticipated to be a problem.

Conclusion:
Based on the normal operating environment, the minimum alloy recommended is a 316L stainless steel.

e Crevice Corrosion
See Pitting.

Conclusion:
See Pitting

f Corrosion at Welds
Corrosion at welds is not considered a problem in the proposed environment.

Conclusion:
Weld corrosion is not considered a problem for this system.

g Microbiologically Induced Corrosion (MIC)
The proposed operating conditions on the process side are generally too warm for microbe growth. Further, because the source of the fluid is from the evaporation of a process fluid, no microbes are expected to be present.

Conclusion:
MIC is not considered a problem.

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h Fatigue/Corrosion Fatigue
Corrosion fatigue is not anticipated to be a problem.

Conclusions
Not expected to be a concern.

i Vapor Phase Corrosion
The vapor phase portion of the shell will be continually washed with condensing vapors.

Conclusion:
No vapor phase corrosion is anticipated.

j Erosion
Velocities are expected to be low. Erosion allowance of 0.004 inch for components with low solids content (< 2 wt%) at low velocities is based on 24590-WTP-RPT-M-04-0008.

Conclusion:
Not expected to be a concern.

k Galling of Moving Surfaces
Not applicable.

Conclusion:
Not applicable.

l Fretting/Wear
Not applicable.

Conclusion:
Not applicable.

m Galvanic Corrosion
For the environment and the proposed alloys, there is not believed to be a concern.

Conclusion:
Not expected to be a concern.

n Cavitation
None expected.

Conclusion:
Not expected to be a concern.

o Creep
The temperatures are too low to be a concern.

Conclusion:
Not applicable.

p Inadvertent Nitric Acid Addition
Higher chloride contents and higher temperatures usually require higher alloy materials. Nitrate ions inhibit the pitting and crevice corrosion of stainless alloys. Furthermore, nitric acid passivates these alloys; therefore, lower pH values brought about by increases in the nitric acid content of process fluid will not cause higher corrosion rates for these alloys. The upset condition that was most likely to occur is lowering of the pH of the vessel content by inadvertent addition of 0.5 M nitric acid. Lowering of pH may make a chloride-containing solution more likely to cause pitting of stainless alloys. Increasing the nitric acid content of the process fluid adds more of the pitting-inhibiting nitrate ion to the process fluid. In addition, adding the nitric acid solution to the stream will dilute the chloride content of the process fluid.

Conclusion:
The recommended materials will be able to withstand a plausible inadvertent addition of 0.5 M nitric acid for a limited period.

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References:

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9. Uhlig, HH, 1948, *Corrosion Handbook*, John Wiley & Sons, New York, NY 10158

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8. Phull, BS, WL Mathay, & RW Ross, 2000, *Corrosion Resistance of Duplex and 4-6% Mo-Containing Stainless Steels i FGD Scrubber Absorber Slurry Environments*, Presented at Corrosion 2000, Orlando, FL, March 26-31, 2000, NACE International, Houston TX 77218.
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10. Zapp, PE, 1998, *Preliminary Assessment of Evaporator Materials of Construction*, BNF—003-98-0029, Rev 0, Westinghouse Savannah River Co., Inc for BNFL Inc.

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WTP Process Corrosion Data

PROCESS CORROSION DATA SHEET

Component(s) (Name/ID #) Waste feed evaporator condensate vessel (FEP-VSL-00005)

Facility PTF

In Black Cell? No

Chemicals	Unit[1]	Contract Max		Non-Routine		Notes
		Leach	No leach	Leach	No Leach	
Aluminum	g/l	1.94E-02	1.86E-02			
Chloride	g/l	2.17E-02	2.46E-02			
Fluoride	g/l	5.58E-04	6.36E-04			
Iron	g/l	2.16E-03	2.30E-03			
Nitrate	g/l	3.64E-01	4.01E-01			
Nitrite	g/l	2.57E-02	2.93E-02			
Phosphate	g/l	4.48E-02	4.99E-02			
Sulfate	g/l	1.69E-02	1.93E-02			
Mercury	g/l					
Carbonate	g/l	7.88E-02	8.42E-02			
Undissolved solids	wt%					
Other (NaMnO4, Pb,...)	g/l					
Other	g/l					
pH	N/A					Note 3
Temperature	°F					Note 2

List of Organic Species:

References

System Description: 24590-PTF-3YD-FEP-00001, Rev 0
Mass Balance Document: 24590-WTP-RPT-PR-04-0001, Rev A
Normal Input Stream #: FEP08, FEP12
Off Normal Input Stream # (e.g., overflow from other vessels): N/A
P&ID: N/A
PFD: 24590-PTF-M5-V17T-P0004001, Rev 0
Technical Reports: N/A

Notes:

1. Concentrations less than 1x 10^{-4} g/l do not need to be reported; list values to two significant digits max.
2. Tnormal operation 111 °F to 122 °F (24590-PTF-MEC-FEP-00001, Rev B)
3. pH approx 10 to 11

Assumptions:

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24590-WTP-RPT-PR-04-0001, Rev. B
WTP Process Corrosion Data

4.4.3 Waste Feed Evaporator Condensate Vessel (FEP-VSL-00005)

Routine Operations

The condensate draining from the primary condenser is monitored for radioactivity. The area radiation monitor is located close to the condenser outlet to allow a time lag before the condensate can reach the condensate vessel (FEP-VSL-00005). This is to minimize the possibility that contaminated condensate can be transferred to the radioactive liquid waste disposal system (RLD). As the condensate vessel fills, the waste feed evaporator condensate pump (FEP-PMP-00006A/B) recirculates condensate continuously back to the vessel with a portion recycled to the SEP vessel for spraying the demister pads.

Non-Routine Operations that Could Affect Corrosion/Erosion

None identified.